Gflash Hadronic Lateral Profile Tuning

Pedro A. Movilla Fernández (LBNL)

Simulation Group Meeting

Dec 15th, 2005

Overview

- This update:
  - Central part
  - Include new data up to 40 GeV/c
  - Lepton veto consistent with Shawn's studies
  - More statistics
  - Fit details slightly modified
- How to combine with plug result?
  (simulation group meeting 12/01/05)
- Conclusions

Lateral Profile Tuning Update

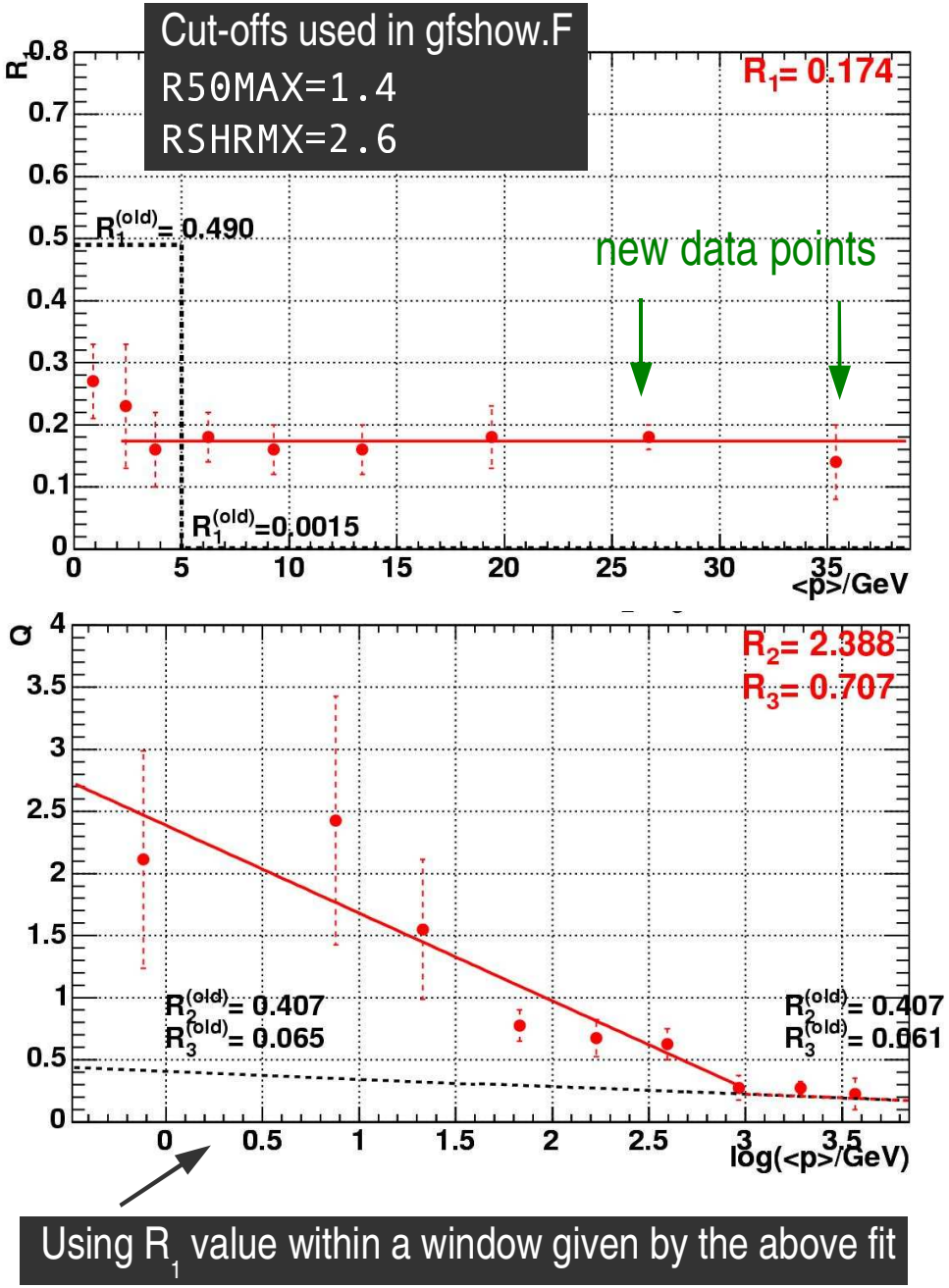
- Tune variable: E/p profile using target tower plus the two adjacent towers in η^{rel}, normalized to absolute data response
- Single isolated track data:
  p≤16GeV/c: gjtc0d
  p>16GeV/c: gjtc0h_stt15
  tower 1-4
- MC: FakeEv, $\pi^{\pm}/K^{\pm}/p\bar{p}$ (6/3/1)

Gflash hadronic lateral profile

$$f(r) = \frac{2 r R_0^2}{(r^2 + R_0^2)^2} \qquad \langle R_0(E, x) \rangle = R_1 + Q x$$
$$Q = R_2 - R_3 \log(p/\mathrm{GeV})$$

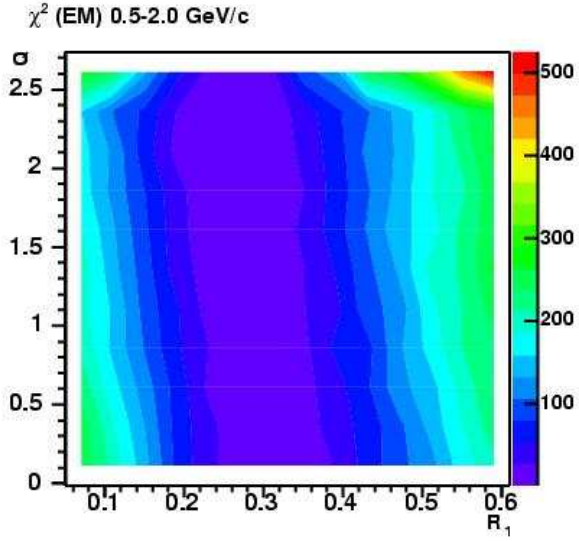
- Extract R1 and Q individually in 9 momentum bins:
  - HAD and EM compartment probe different x ranges and thus provide complementary information about shower development
  - scan (R_1,Q) plane and compare with reference data to calculate χ^2
  - combine information using "normalized" χ^2
    $\{ \chi^2(EM)/N_1 + \chi^2(HAD)/N_2 \} / \mathrm{Min}\{ \chi^2(EM)/N_1 + \chi^2(HAD)/N_2 \}$
  in order to constrain the parameters and to estimate sensitivity
- R_2 and R_3 determined from momentum dependence of Q using R_1 constraint

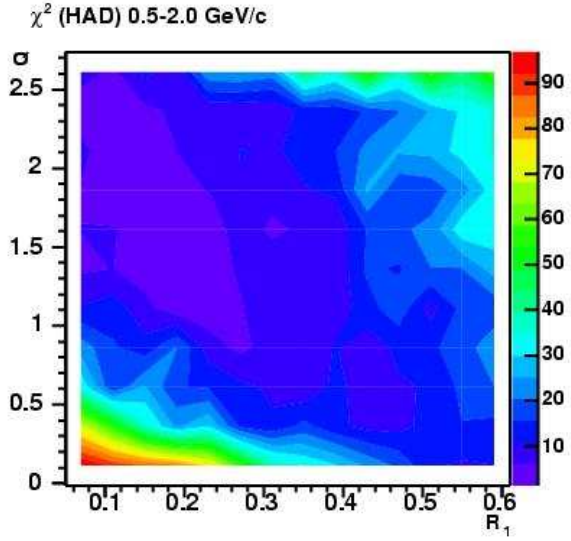
Tune Results (Central)

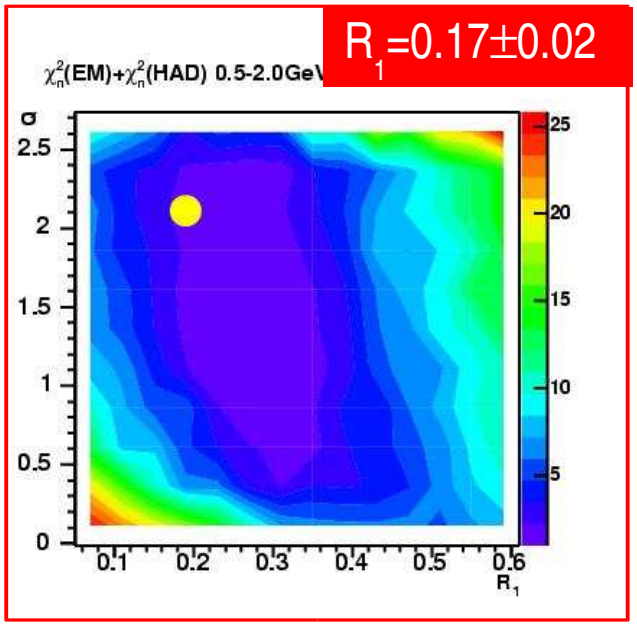


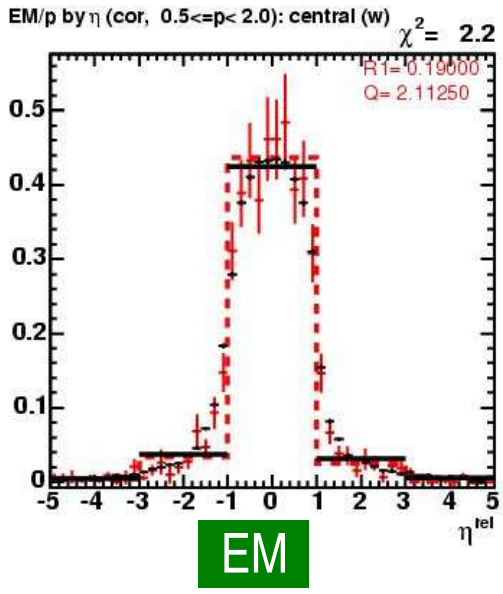
- Core term very stable, spread term difficult to constrain.
- "Error" bars shown indicate variation of a given parameter necessary to increase the normalized χ^2 by one unit (not a real error)
- Fits do not use "error" bars.
- At p<3 GeV/c, Q and R_1 can be traded against each other to achive linearity while keeping quality of data description reasonable ($\rightarrow$ R_1 constraint, see distributions)
- Exact value of Q slope or its functional form is not crucial at low p (NB: intersection of fit with H1 default at 24 GeV is just coincidence.)
- Useful parametrization for Gflash:
  p<20GeV/c: result for linear Q-fit
  p>20GeV/c: switch to H1 default (supported by the two new data points)

Central, 0.5-2.0 GeV/c

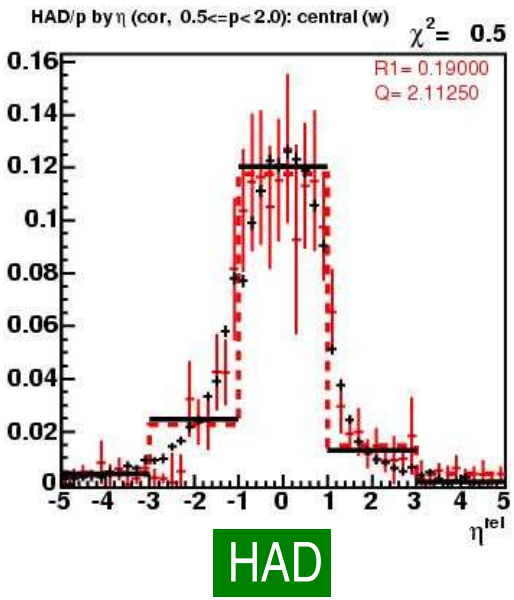




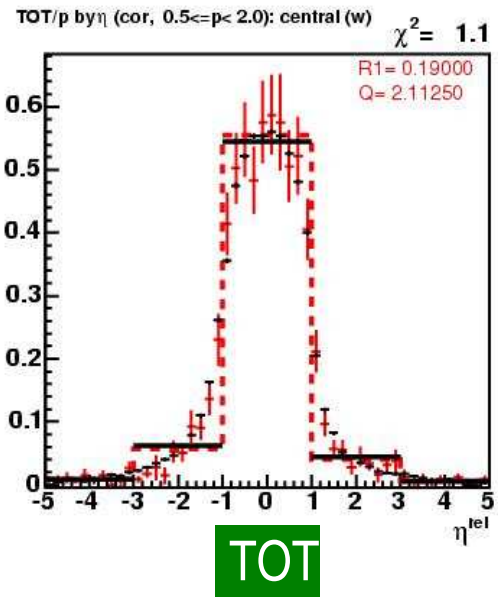




EM

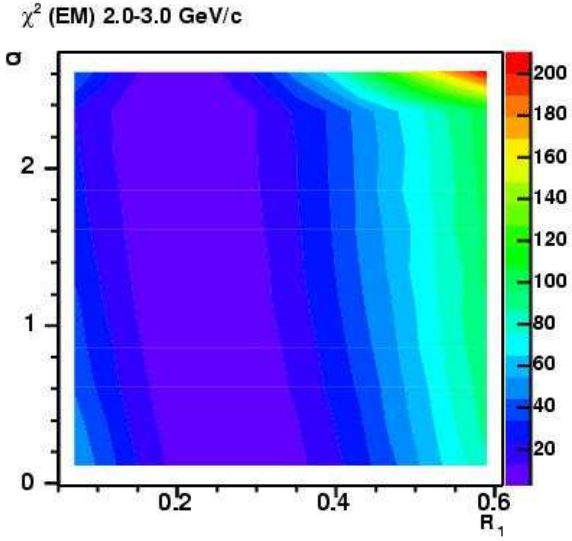


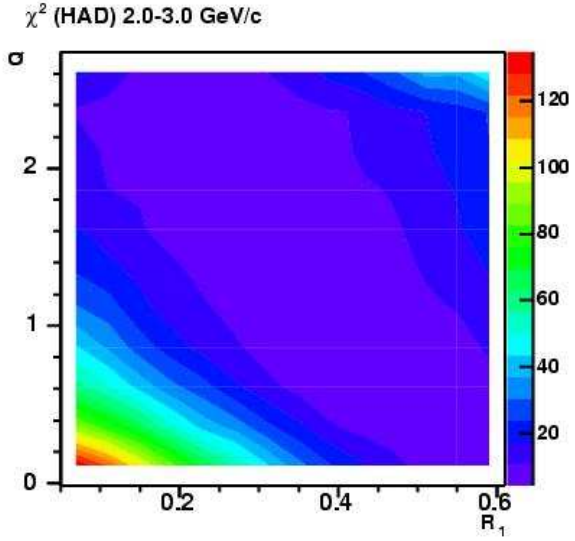
HAD

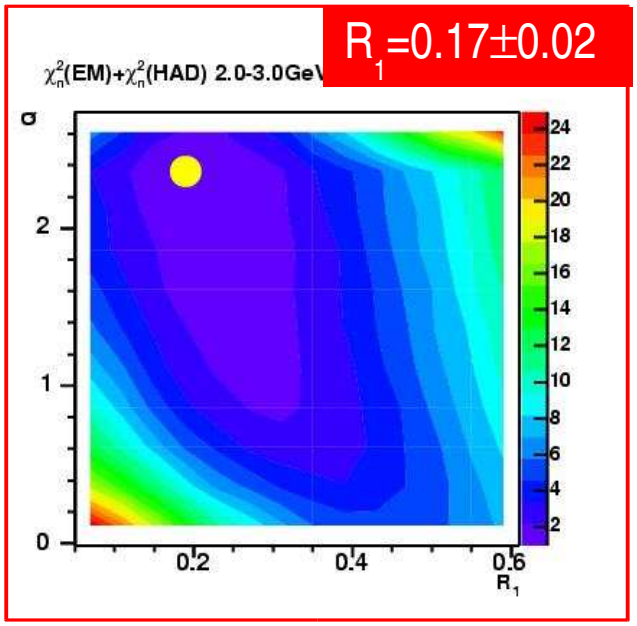


TOT

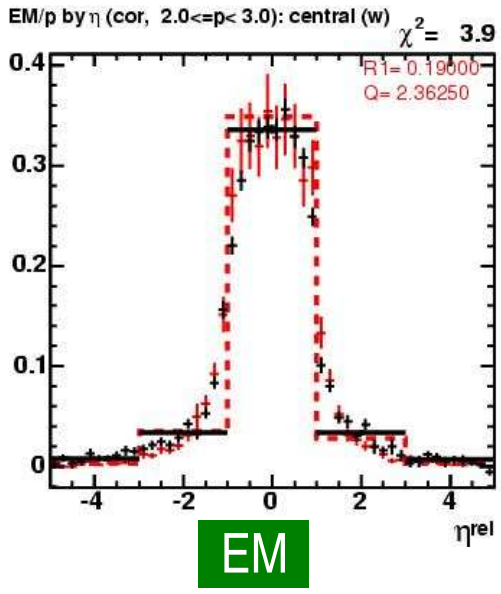
Central, 2-3 GeV/c



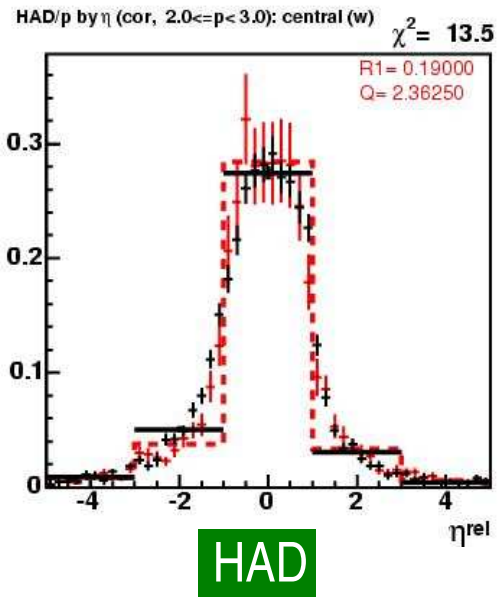




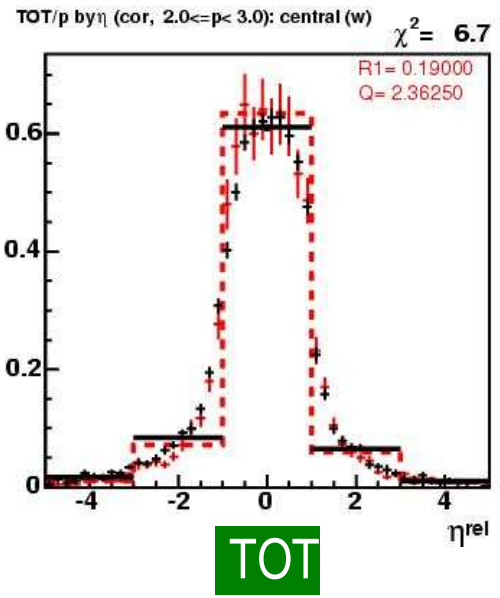
R_1=0.17±0.02



EM

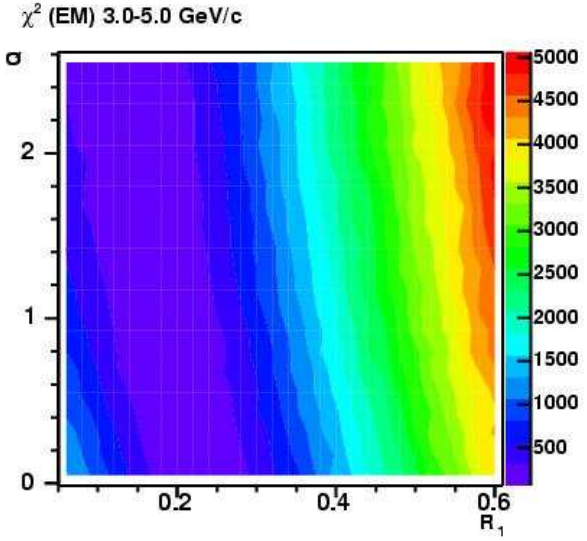


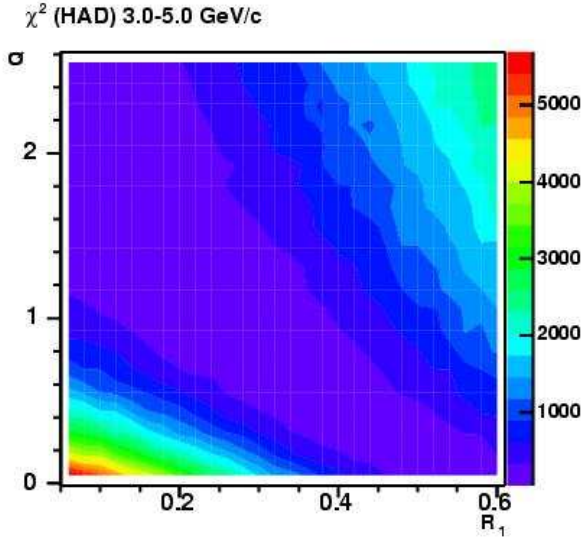
HAD

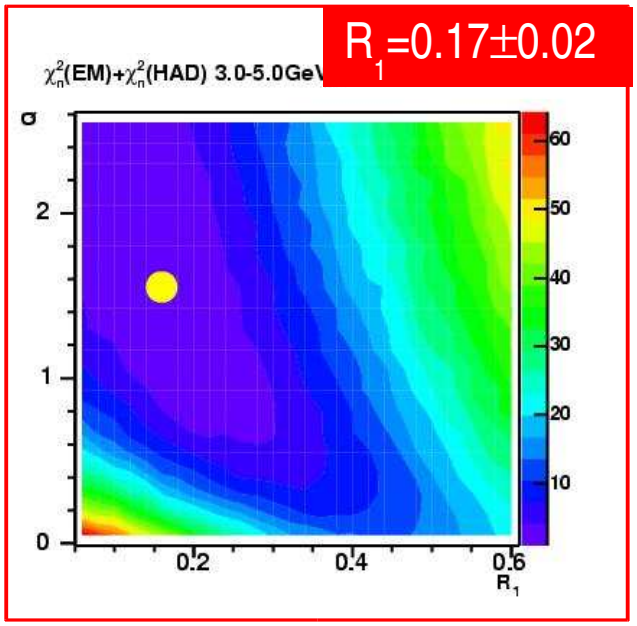


TOT

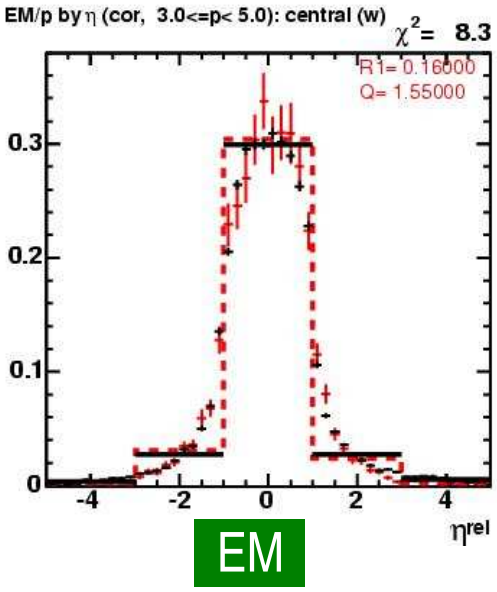
Central, 3-5 GeV/c



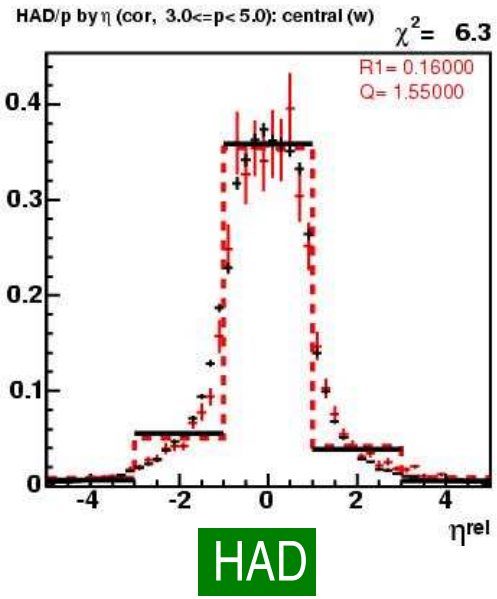




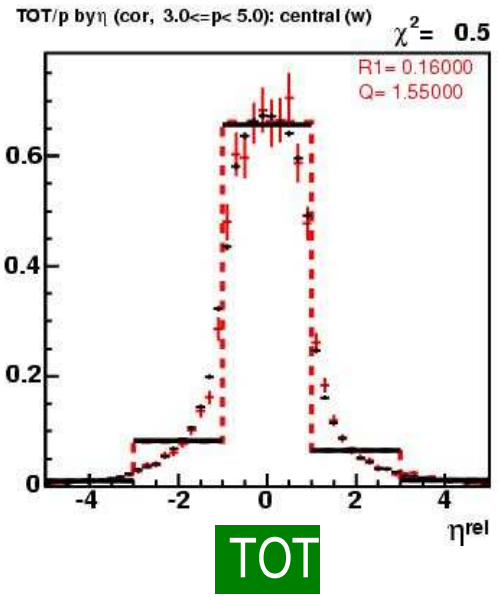
R_1=0.17±0.02



EM

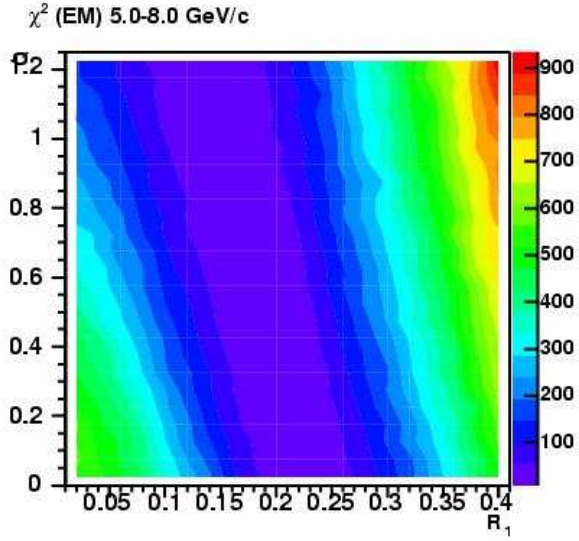


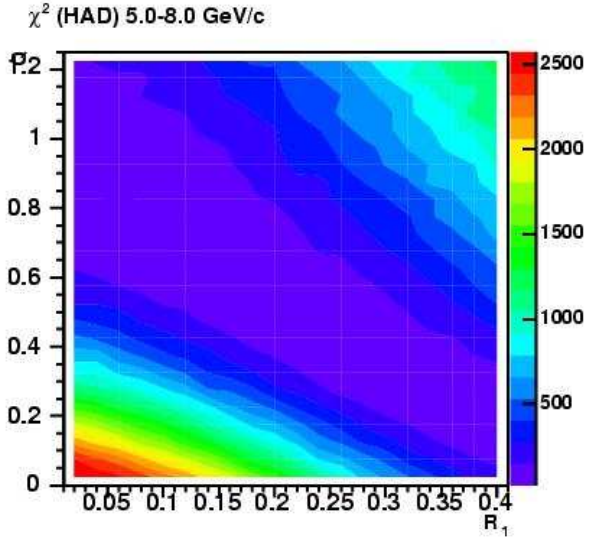
HAD

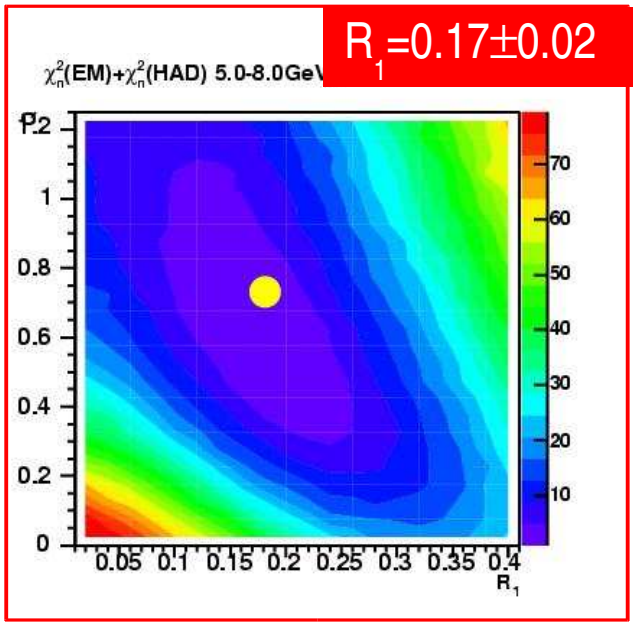


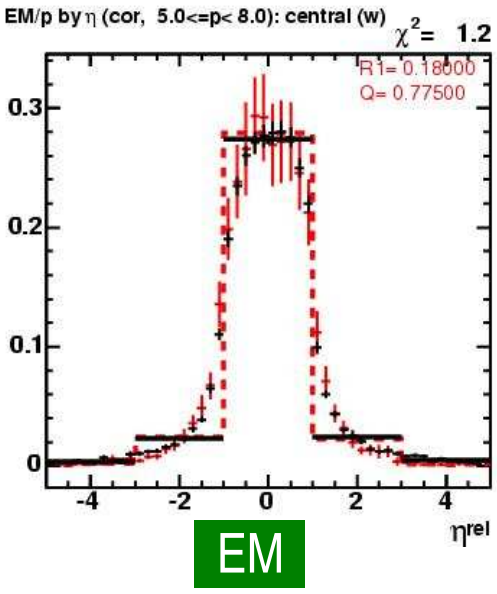
TOT

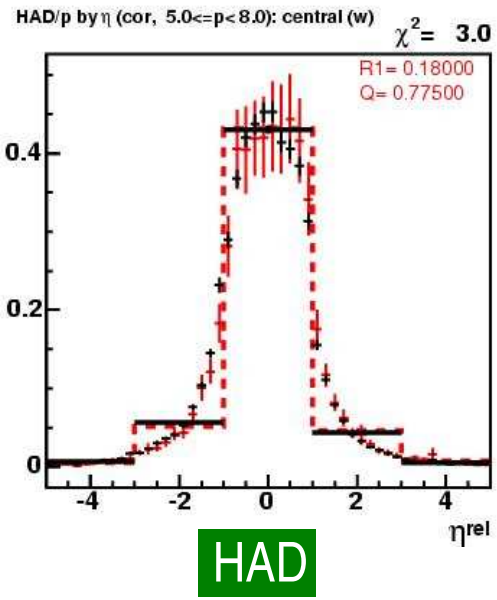
Central, 5-8 GeV/c

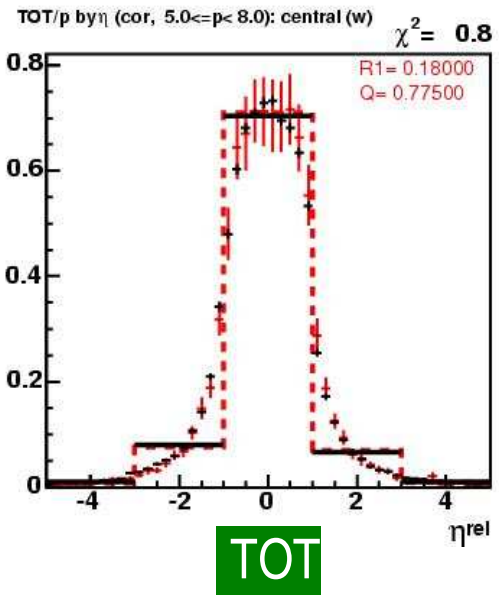




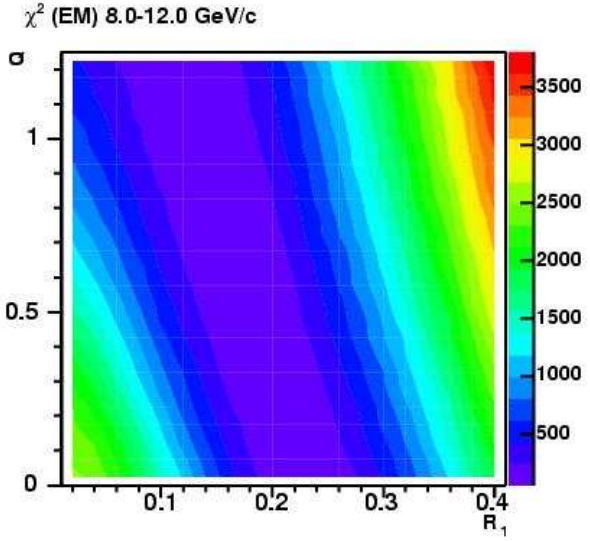


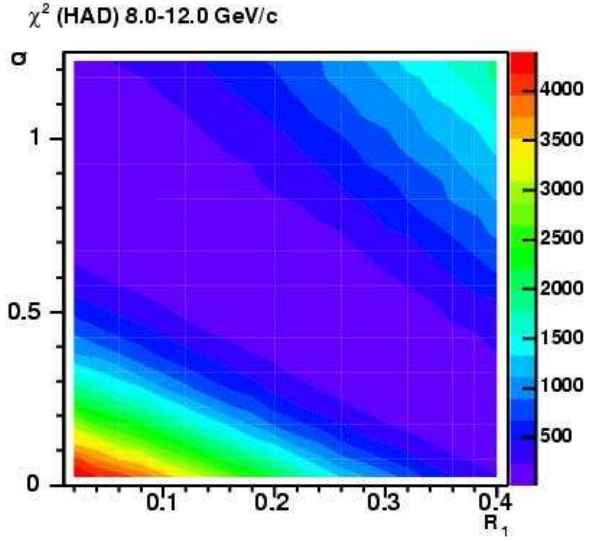


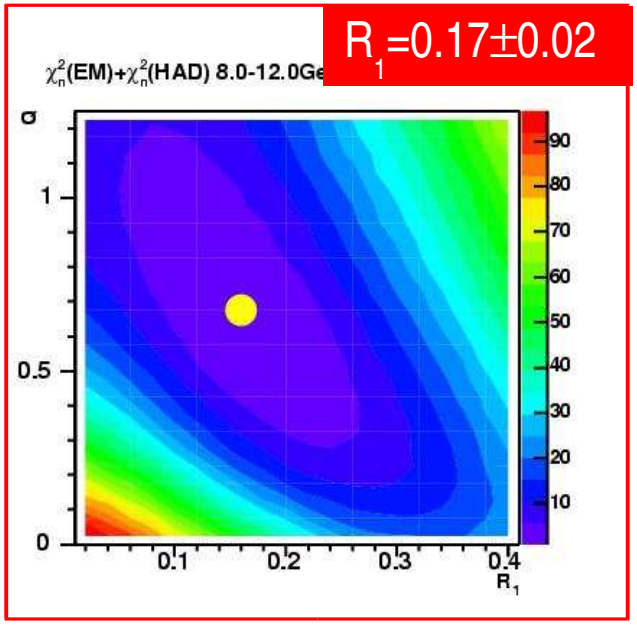


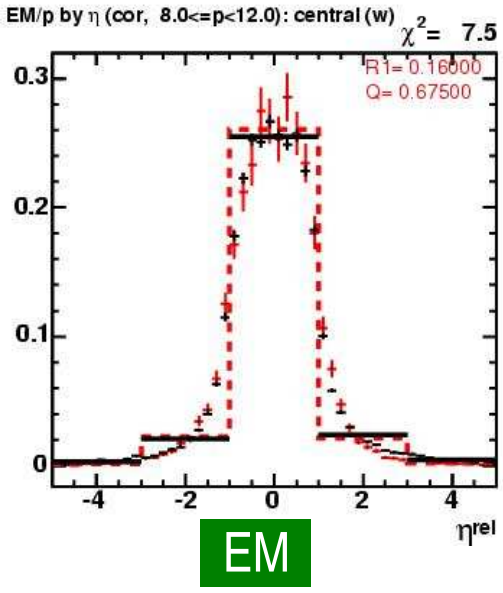


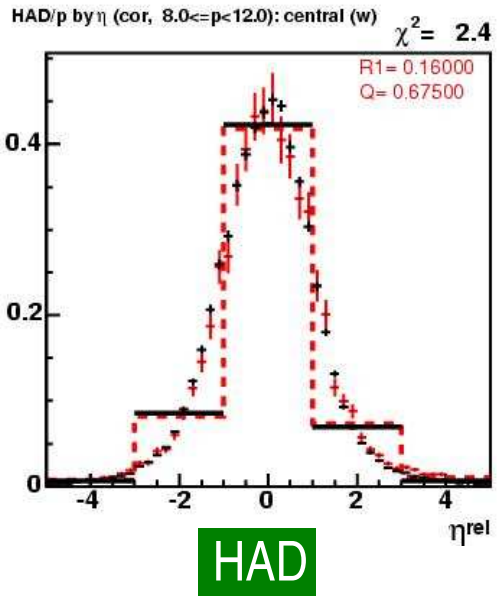
Central, 8-12 GeV/c

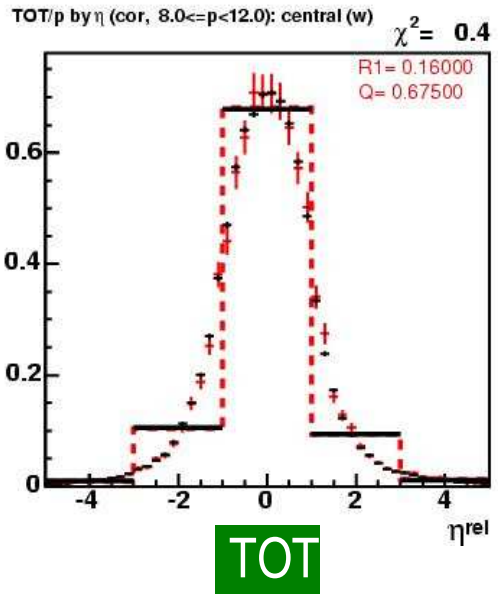




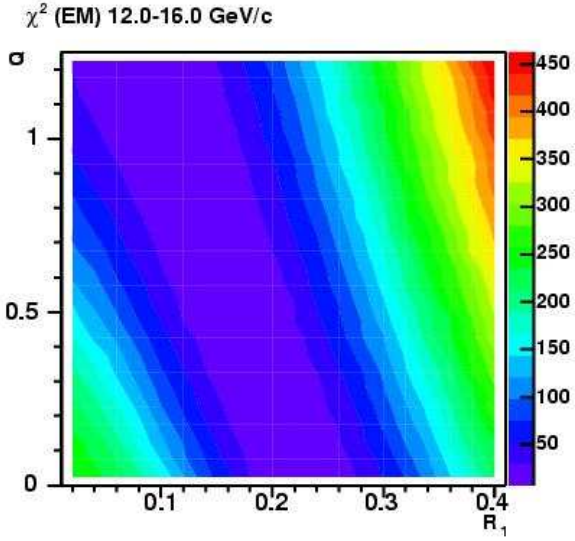


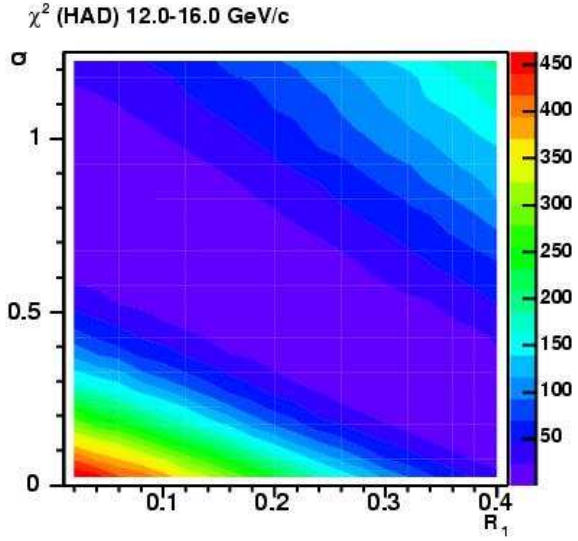


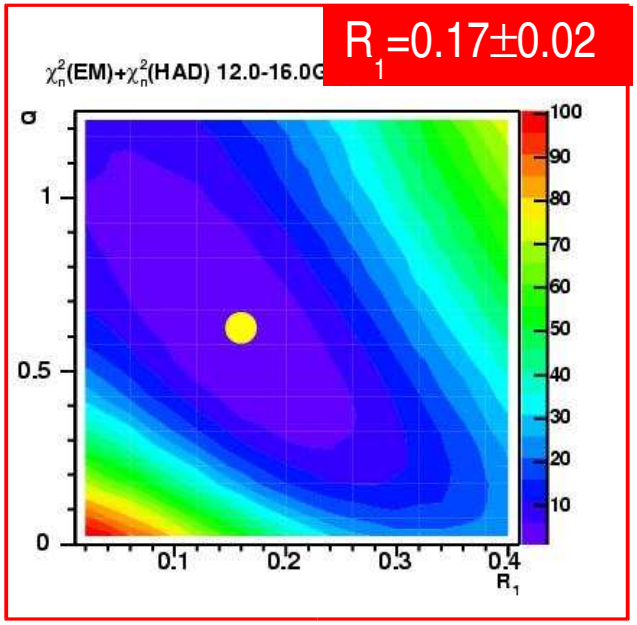




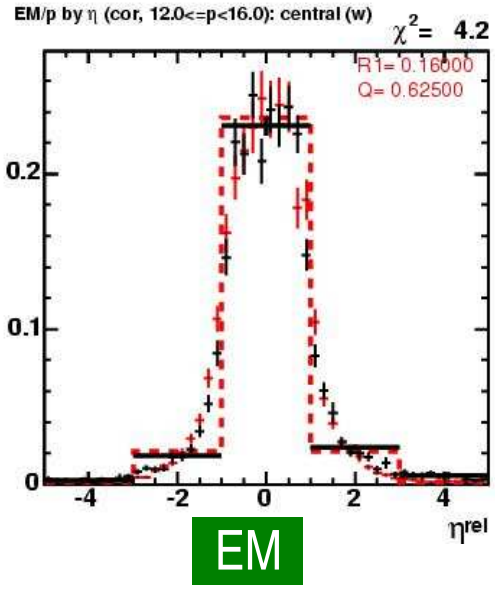
Central, 12-16 GeV/c



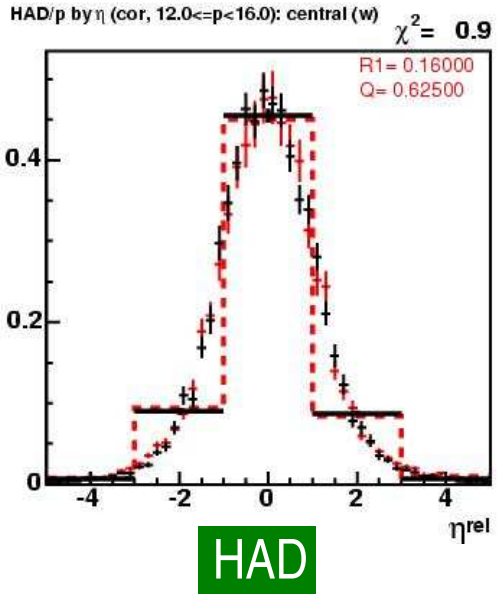




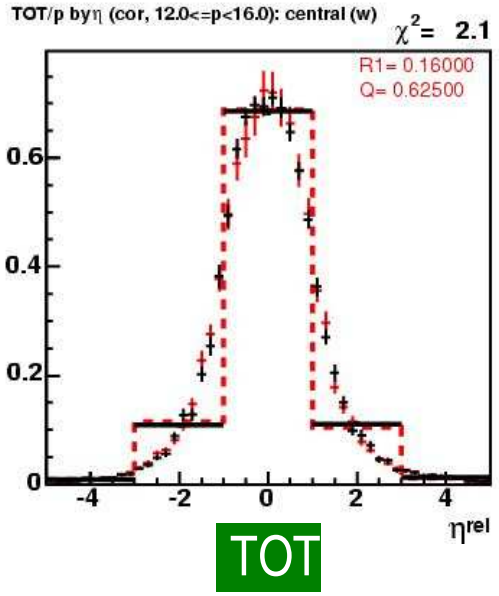
R_1=0.17±0.02



EM

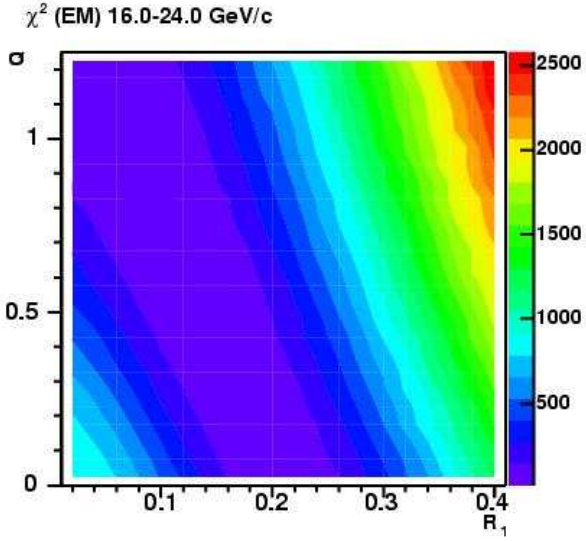


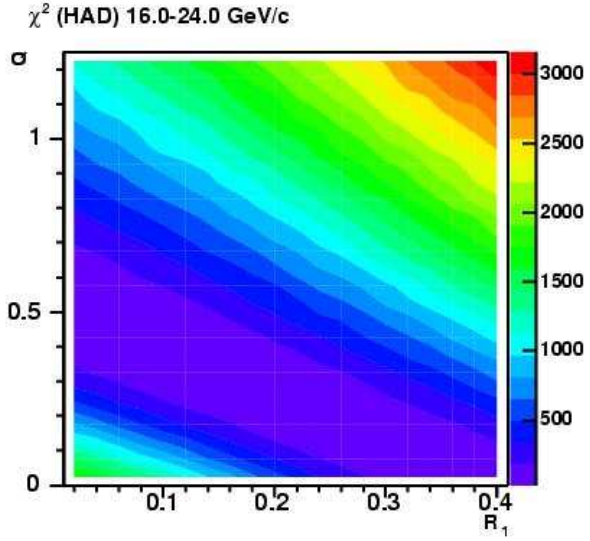
HAD

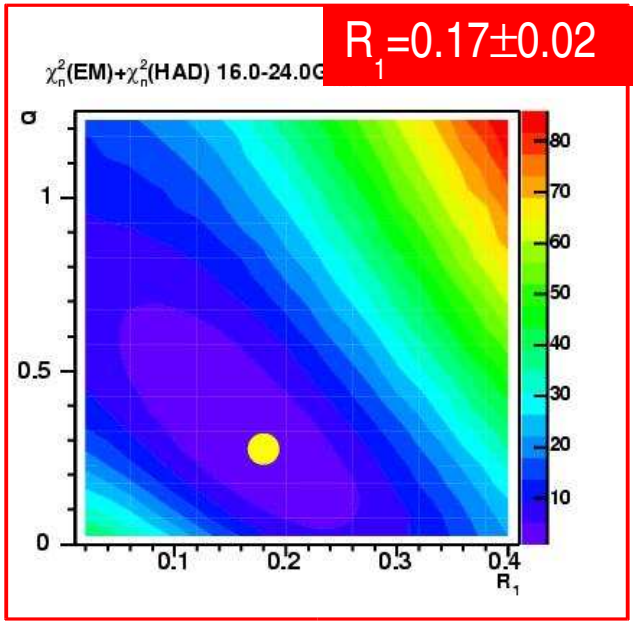


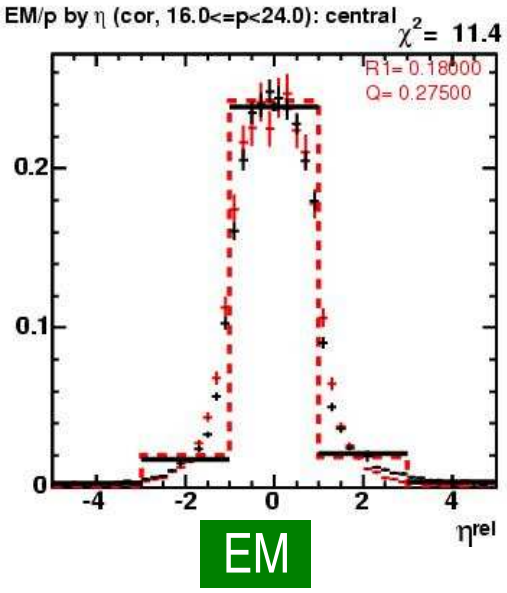
TOT

Central, 16-24 GeV/c

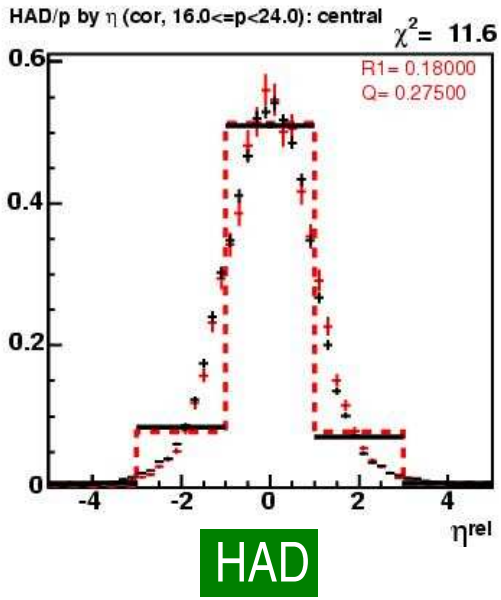




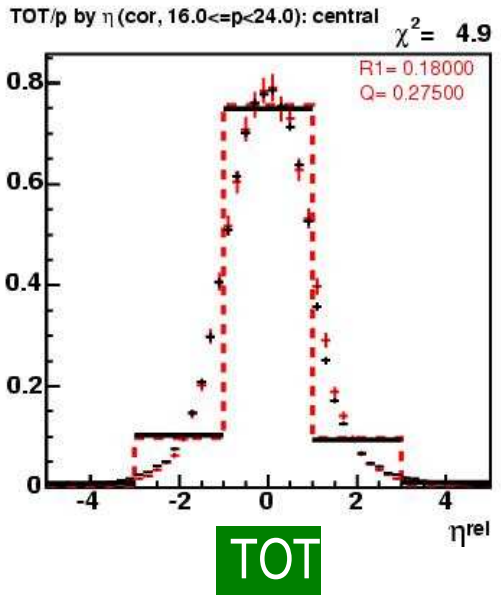




EM

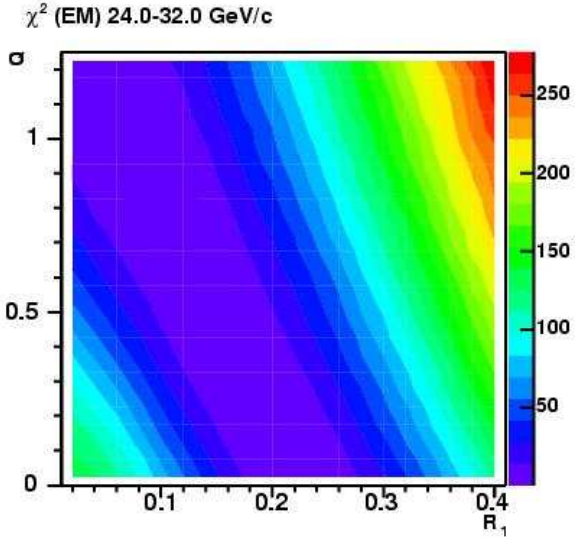


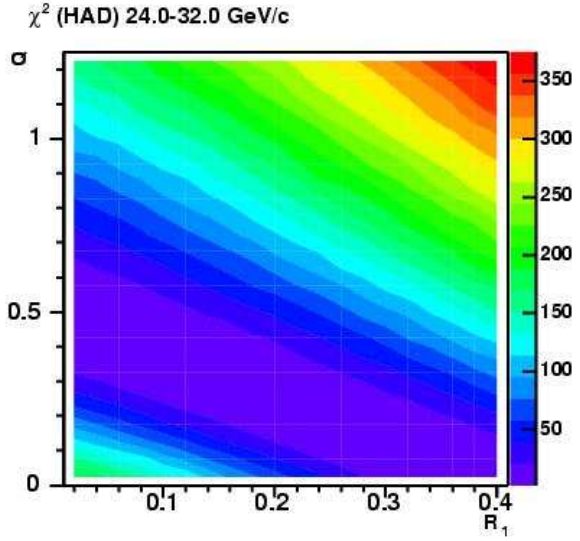
HAD

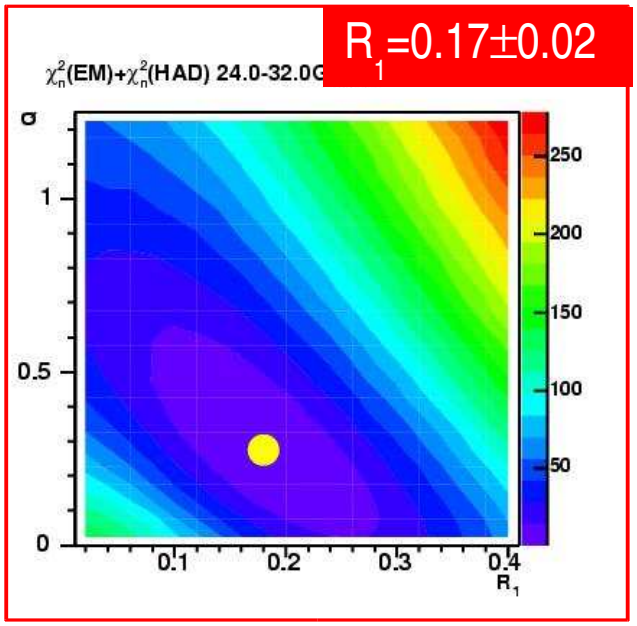


TOT

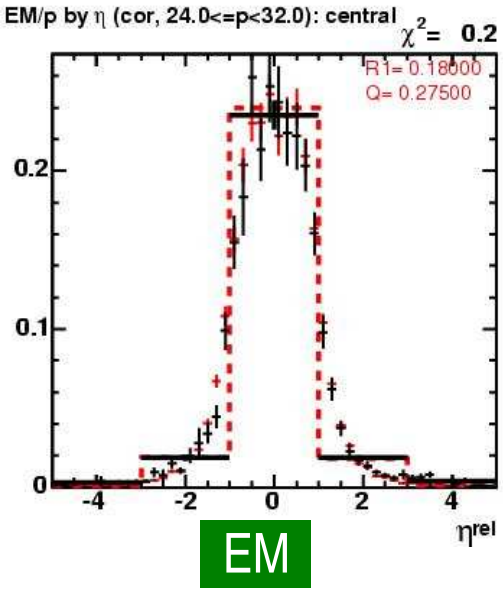
Central, 24-32 GeV/c



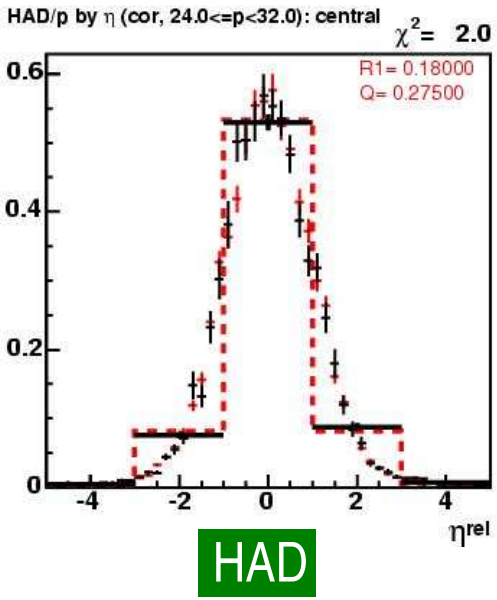




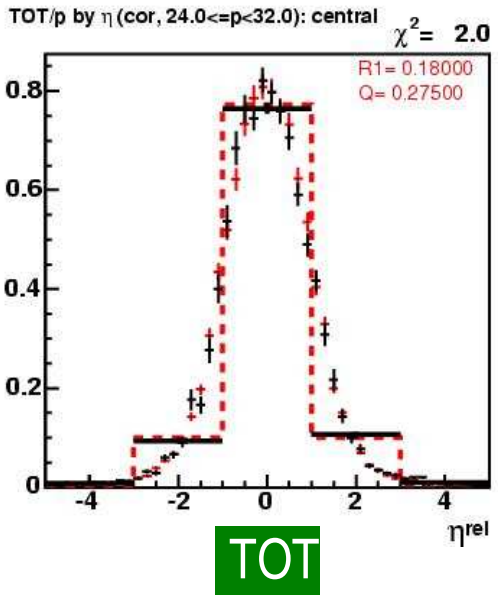
R_1=0.17±0.02



EM

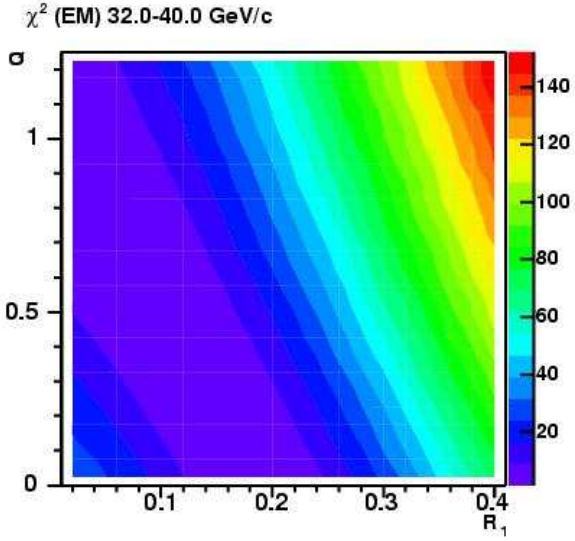


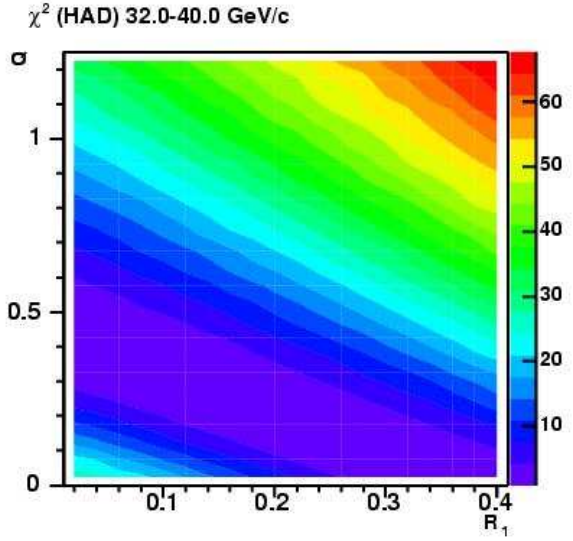
HAD

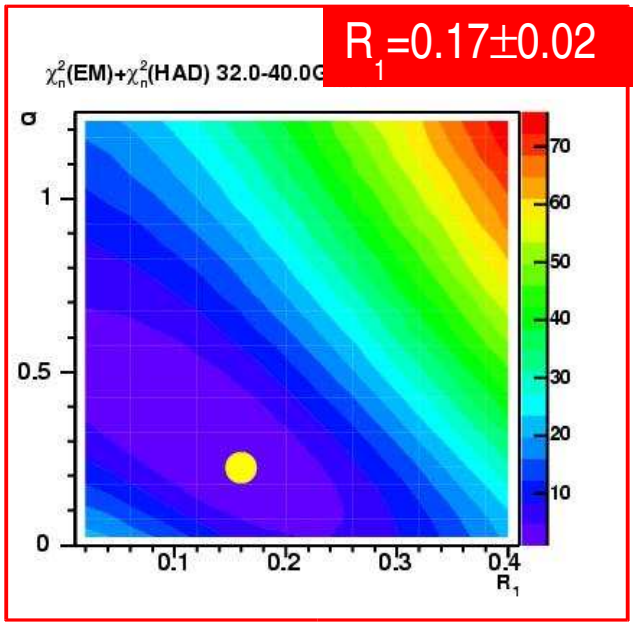


TOT

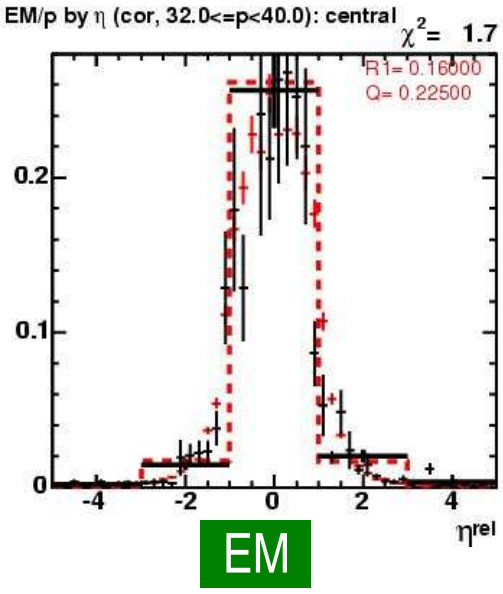
Central, 32-40 GeV/c



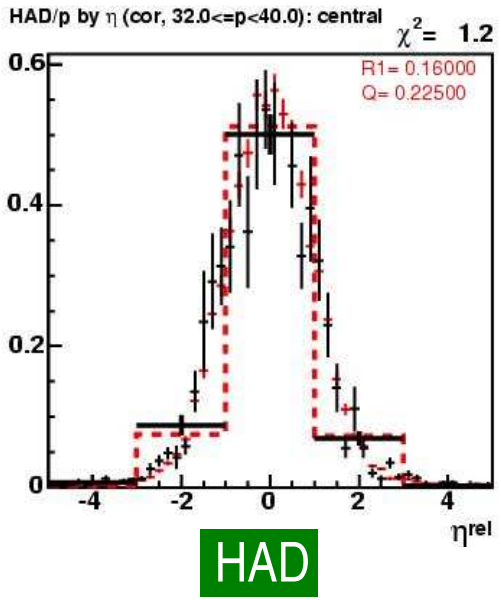




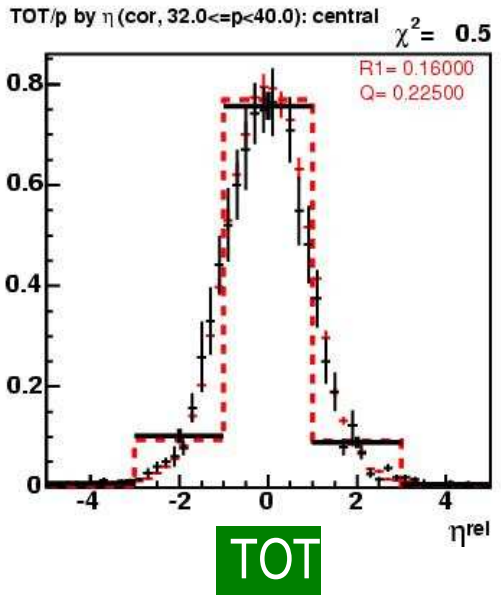
R_1=0.17±0.02



EM



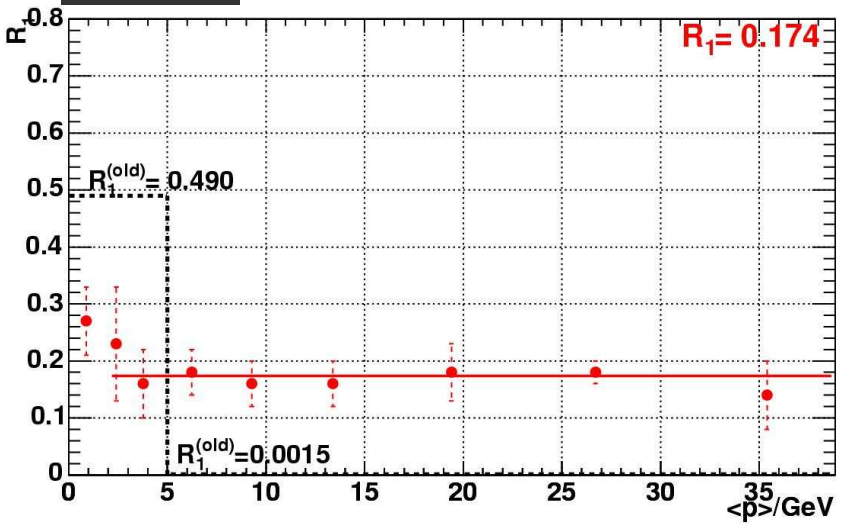
HAD

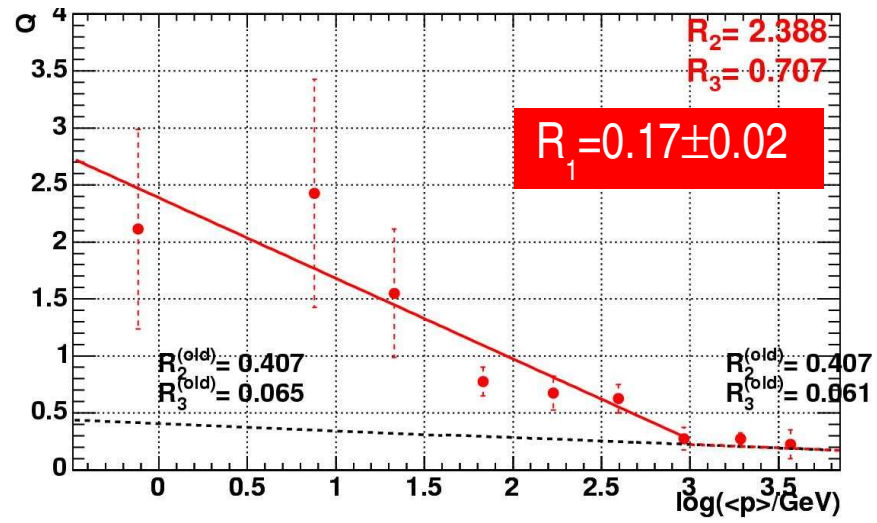


TOT

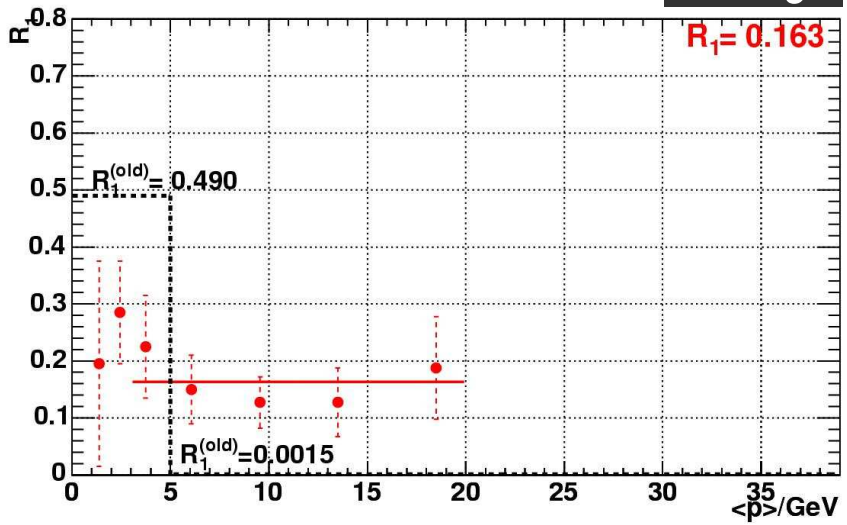
Central vs. Plug

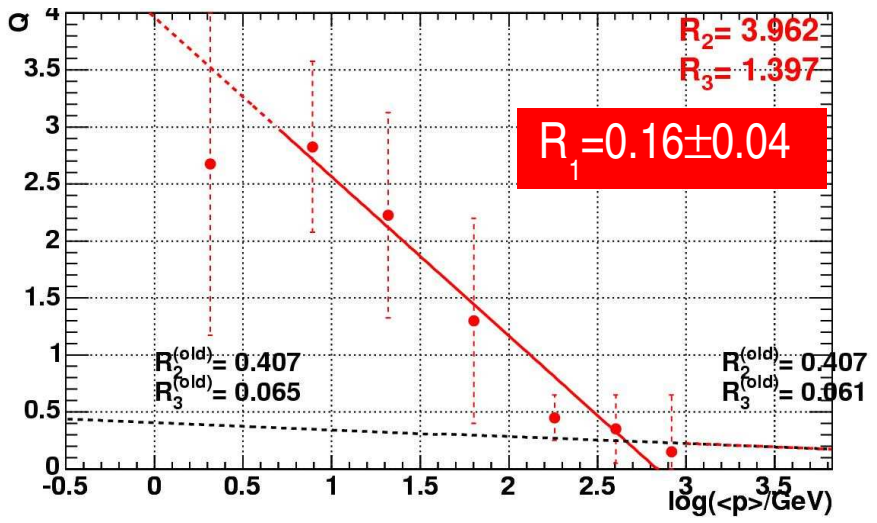
Central





Plug





- Core term similar, spread term has steeper behaviour in plug region
- Plug needs more MC track statistics for tuning (still on the way)

Conclusions

- Updated central tuning results ok to be included in Gen-6.
- Central versus Plug:
  - Use same constant R_1 value up to 40 GeV/c (and beyond).
  - Suggest to use either the different optimized R_2 and R_3 values for Central and Plug or just the better established Central results for the whole calorimeter, but no average.
  - For p>20GeV/c use H1 default for R_2 and R_3 in Central and Plug.
- New tuning does not necessarily contradict past Gen-5 tuning for p<5GeV/c:
  - We reduced lateral core contribution but need to increase spread term
    $\rightarrow$ may leave the profile for a given momentum bin unchanged.
  - Now that we can study the momentum dependence over a larger momentum range we can better disentangle core and spread part.
  - Also certain upper shower cut-offs were relaxed w.r.t. Gen-5
    $\rightarrow$ is expected to reduce R_1